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LARVAL DEVELOPMENT, GROWTH AND SURVIVAL OF LABORATORY REARED *CHRYSICHTHYS NIGRODIGITATUS* (LACEPEDE)

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Abstract
The early development and growth of *Chrysichthys nigrodigitatus* larvae are described from laboratory – reared specimens. Fertilized eggs were collected from wild parental fish which were made to hatch inside bamboo tube. The larval length increased from 6.65mm at hatching to 16.50mm at the end of 10-days of endogenous feeding. Two 'critical periods' associated with high larval mortality were observed on the 3rd – 4th and 7th – 8th days after hatching. These two periods accounted for 46.40% of the total morality rate of 62.22%. A survival rate of 37.78% was recorded.

Keywords: *Chrysichthys nigrodigitatus*, larval development, growth, survival

Introduction
The catfish, *Chrysichthys nigrodi-gitatus* is a warm water species which is cultured in both fresh water and brackish water ponds in Nigeria (Ezenwa 1982; Afinowi and Marioghae 1986). It supports the major part of commercial catches in Nigeria (Fagade and Adebisi 1979; Ikusemiju 1976 and Ezenwa 1978). Irvine (1947) reported that the fish is of common occurrence in the inland waters of West Africa. Inspite of the economic importance of this species, there is dearth of information on its early development and growth.

A clear understanding of larval development and growth of any cultivable fish species is of particular interest to fish culturists, as this will eliminate ill-timed handling and late or inappropriate food introduction.

Marimuthu and Haniffa (2007) reported that studies on larval development of any cultivable fish species can be useful in directing the husbandry efforts of fish farmers to the specific state and requirements of each larval stage.

Several stages of larval development have been described in a number of catfish species *Clarias batrachus* (Thakur 1980), *Clarias gariepinus* (Verreth et al 1992; Segner et al 1993), *Heterobranchus longifilis* (Ogunji and Rahe 1999), *Clarias macrocephalus* (Mollah and Tan 1982).

This study was designed to describe and illustrate the early development and growth of C. *nigrodigitatus* larvae reared under laboratory conditions during the endogenous feeding period.

Materials and Methods
Gravid male and female were induced to spawn inside a bamboo tube in Asejire lake Oyo State, Nigeria as described by Adewolu (1997). The eggs were collected from parent fish and brought to the laboratory in a jar of water. A total of 807 eggs were placed in 50 liters of aquarium tank containing dechlorinated tap water. The temperature of the water was 23.5 ± 0.5^0C, dissolved oxygen was 6.90 ± 0.35mg/1 and pH was 6.95±0.02. Gentle

aeration was provided throughout the larval developmental stages.
Between 5 and 8 individual of the larvae were removed every 24 hours for yolk sac, total length measurements and for morphological observations. Larval length was measured from the tip of the upper jaw to the distal extremity of the 'tail' using a graph paper calibrated in millimeters. The morphological features of the developing larvae were observed under a binocular microscope fitted with an eyepiece graticule reading to an accuracy of 0.02mm. Larvae were weighed on a Mettler balance to the nearest 0.0001g. The specimens were preserved in labeled bottled containing formolacetic alchol (F.A.A.) (Kahle's fluid).
Dead larvae were checked twice daily (morning and evening) and were removed by siphoning, counted and recorded.
Percentage mortality was calculated daily. Water in aquaria tanks was changed daily. The larvae were reared until the yolks were completed utilized.

Results

Morphological and Behavioural Observation of Larval Development:

Newly hatched (1day old)
The head of the newly hatched larva was somehow curved over the yolk sac. The notochord was visible. There was the presence of finfold covering the entire length of the posterior part of the body. Eye pigmentation was observed, and there were pigmentations on the head. Larvae were observed to cluster in masses in the dark corners of the rearing tank, displaying sporadic movement. The average weight was 4.65±0.13mg, while the total body length was 6.65 ± 0.03mm. The yolk sac diameter was 4.50 + 0.02mm (Fig. 1).

2 day old larva
The segmentation of the notochord was clearly visible. Optic vesicle was also visible. Lower jaw remained attached to the yolk. There was a slight decrease in the size of yolk sac, about 4.30 ± 0.02mm in diameter. The length of the body had increased to 7.5 + 0.01mm weighing 5.20 ± 0.25mg. Larval activity tended to increase with muscular flextures of the tail. Pigments were still found on the head of larva (Fig. II).

3 to 4 day old larva
The optic vesicles increased in size. The head had completely straightened out. Mouth had started forming in the ventral position. The lower jaw had slightly projected beyond the yolk. The snout pointed downward and finfold was still present. Blood was visible in circulation. The yolk sac diameter of 4.50 ± 0.22 at hatching had decreased to an average of 3.80 ± 0.15mm. The larval had increased in size with a mean total length of 9.00 ± 0.25mm, weighing 8.5 ± 0.17 mg (Fig. III).

4 – 5 day old
Mouth had widened and almost terminal in position. Optic vesicles had increased in size and pigmentation of the eye had increased. Formation of a pair of barbel was observed as skin fold on the lower jaw. The lower jaw had projected further away from the yolk sac. There was appearance of fins as finbuds within the finfold. Lower and upper jaws were vibrating. Larva was capable of moving vertically but the yolk prevented it from floating. Yolk sac continued to decrease in size to a mean diameter of 1.75 ± 0.23mm while larval length and weight were 13.20 ± 0.14mm and 15.70 ± 0.21mg respectively (Fig. IV).

6 – 8 day old
Eye increased in size and was deeply pigmented. All fins had developed and their rays were visible. The caudal fin was in homocercal condition (truncated). There was a flange of finfold connecting dorsal and caudal fins to the anal fin. There was increase in the spread of melanophores. The last vestige of the yolk sac was still present, about 0.50 ± 0.01mm. The weight of the larva reduced to 13.10 ± 0.01mg and length was 13.50mm. Larva accepted cultured zooplankton as first food (Fig. V)

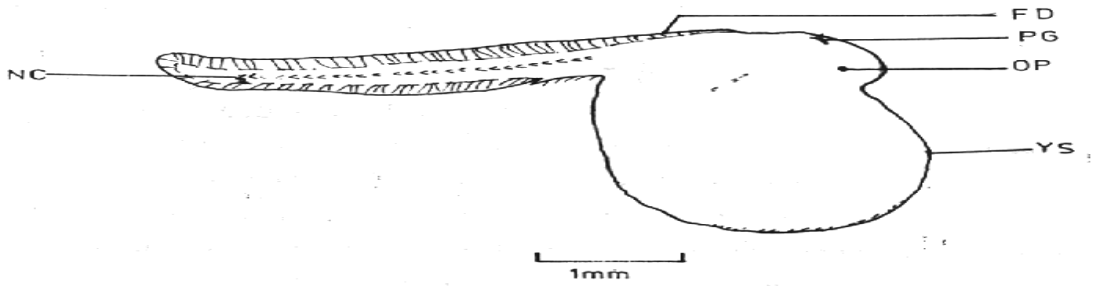

Fig. I – Newly hatched larva of *Chrysichthys nigrodigitatus*

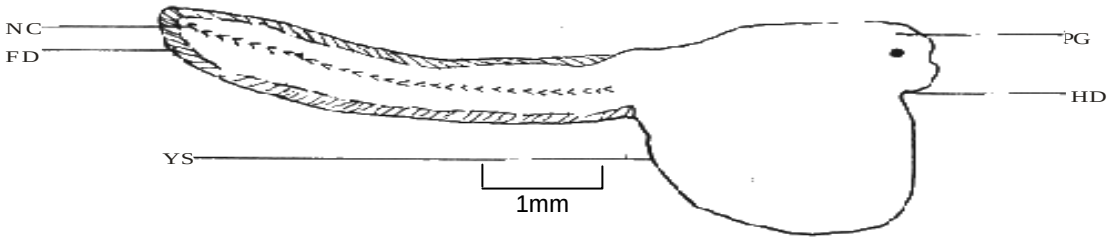

Fig.II: 2 day old larva of *Chrysichthys nigrodigitatus*

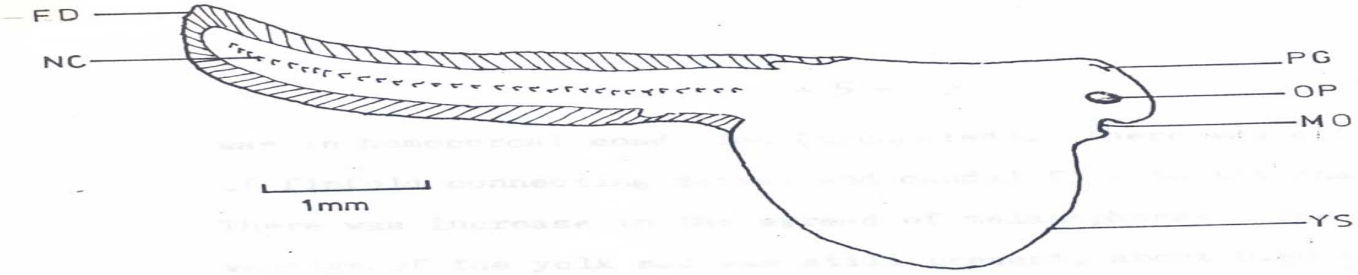

Fig. III : 3-4 day old larva of *Chrysichthys nigrodigitatus*

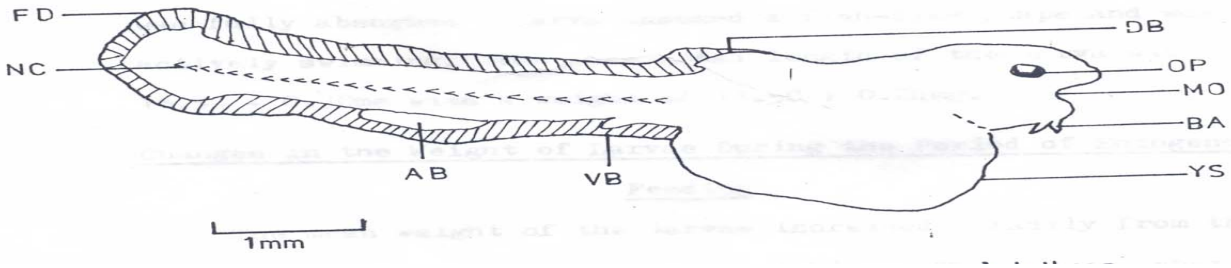

Fig. IV : 4 to 5 day old larva of *Chrysichthys nigrodigitatus*

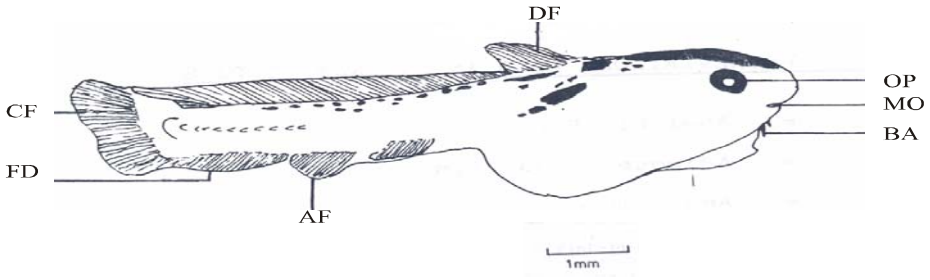

Fig. V: 6-8 day old larva of *Chrysichthys nigrodigitatus*

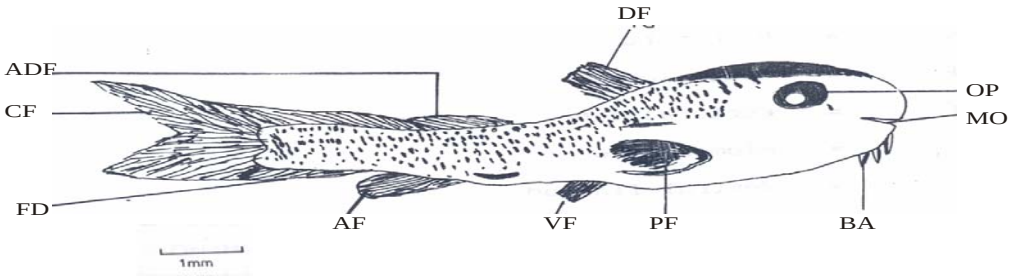

Fig. VI: 9-10 day old larva of *Chrysichthys nigrodigitatus*

List of Abbreviations used in Figures I to VI

AB = Anal fin bud. ADF = Adipose dorsal fin. AF = Anal Fin. BA = Barbel. CF = Caudal fin. DB = Dorsal fin bud. DF = Dorsal fin. EYP = Eye pigmentation. FD = Finfold. HD = Head. MO = Mouth. NC = Notochord. OP = Optic lobe. PF = Pectoral fin. PG = Pigmentation. VB = Ventral fin bud. VF = Ventral fin. YS = Yolk sac

9 – 10 day old

The eye had further increased in size and mouth completely formed. All fins were very distinct; the dorsal fin had been ossified and assumed a fan-like shape. The ventral fins had differentiated out, and the caudal fin was already tuncated. Melanophores had spread to all parts of the body. The yolk sac was fully absorbed. Larva assumed a fish-like shape and was actively swimming. The mean total length of the larva was 16.50 ± 0.30mm with a weight of 13.50 ± 0.24mg (Fig. VI).

Changes in the Weight of Larvae during the Period of Endogenous Feeding

The mean weight of the larvae increased steadily from the first day to the fifth day after hatching. There was a sharp drop from sixth day to the eight day, and increased slightly on the 10th day which marked the end of the endogenous feeding (Fig. VII).

Mortality Rate

Mortality during the initial ten days after hatching is presented in Table 1. High mortalities occurred twice during the first 10 days of life. The first high mortality took place on the 3rd and 4th days and accounted for 9.46% and 9.15% respectively. A second major mortality of 14.26% and 13.49% occurred on the 7th and 8th day respectively. These two critical periods accounted for 46.40% of the total mortality rate of 62.22%. The lowest mortalities were, however, found on the 1st day and 2nd day of larval development. A final survival rate at the end of the 10 days of endogenous feeding was 37.78%.

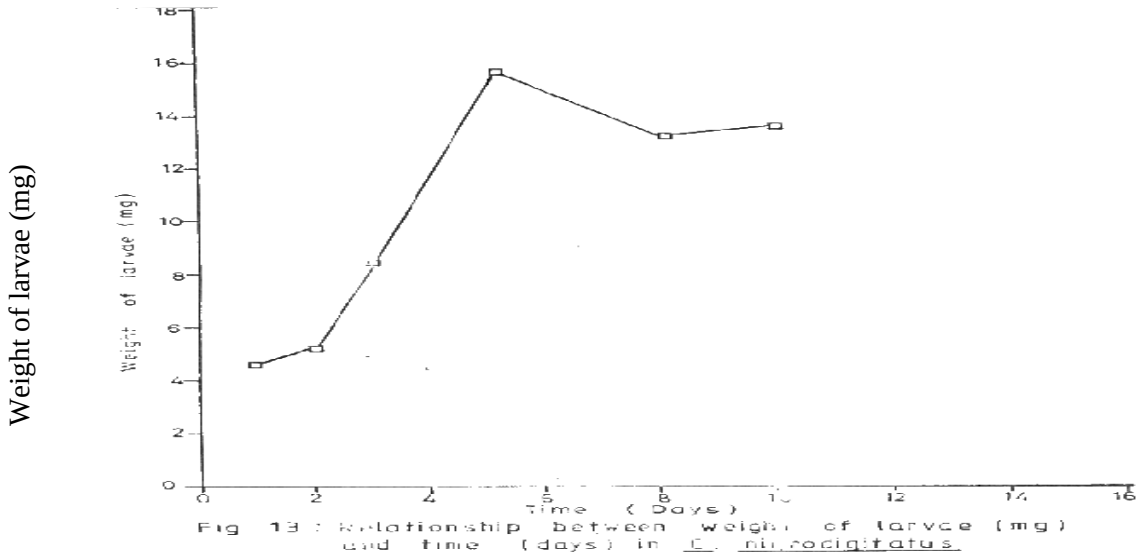

Fig. 13: Relationship between weight of larvae (mg) end time (days) in *C. nigrodigitatus*

Table 1: Mortality of *Chrysichthys nigrodigitatus* during the endogenous feeding period

Time (Days)	No. of Dead Larvae	Percentage Mortality
1	7	1.08
2	9	1.40
3	61	9.46
4	59	9.15
5	21	3.26
6	31	481
7	92	14.20
8	87	13.49
9	22	3.41
10	12	1.87

Discussion

The observed developmental stages of C. *nigrodigitatus* larvae followed the normal teleostean pattern as described by Blaxter (1969). The newly hatched larva lacked mouth and functional eye, suggesting that the larvae were living absolutely on the yolk. The increase in the average total length of larvae and the proportional decrease of yolk sac diameter also showed that the larvae used the endogenous food reserve for growth and development. The yolk sac was completely utilized on the 10th day of hatching. In *Clarias gariepinus,* Bamimore (1989) reported that the yolk sac was completely utilized on the 5th day of hatching. Ogunji and Rahe (1999) reported a complete disappearance of yolk sac of Heterobranchus longifilis on 55 hours after hatching. Complete disappearance of yolksac of *Clarias lazera* has been observed on the 4th day.(Panjion ghua and Zheng wenbiao 1982). In *Mystus montanus* the yolksac was fully resorbed after 3rd day (Raj et al 2003). The longer period of yolk utilization in C. *nigrodigitatus* compared with *Clarias gariepinus* might be attributed to its bigger size of eggs (Adewolu, 1997).

The sharp drop in the weight of larvae towards the end of yolk-sac absorption (6th – 8th days) showed that the remaining amount of yolk reserves were not enough for the development and growth of the larvae. During this time the larvae accepted external food (live plankton), since larvae had developed functional eyes and mouths and were capable of moving freely in water. The acceptance of live food during this stage of larval development, according to Kuo *et. al.* (1973) would prevent mortality from irreversible starvation. Bagenal (1969) had earlier reported reduced growth rate and shrinkage of larvae fish towards the end of yolk sac absorption and recommended the immediate feeding of the larvae to avoid total mortality.

Two critical periods involving high mortalities were clearly indicated during the first 10 days of life. The first high mortality rate of 9.15% and 9.46% occurred on the 3rd and 4th respectively, and this period coincided with the opening of the mouth. The second high mortality of 14.26% and 13.49% occurred on the 7th and 8th day respectively, when the yolk of the larva was in the rudimentary stage and could not cope with growth and development of larvae. The two critical periods accounted for 46.40% of the total mortalities of 62.22%. Many workers have reported critical periods of high mortalities during the early larval development and during the weaning stage from endogenous feeding to exogenous feeding (Nickum 1978 and Hansen and Borrensen 1989).

Conclusion

There is scarcity information for Nigerian fish farmers on the larval development and growth of *C. nigrodigitatus.* The observed developmental stages and growth of the larvae will equip the farmers early management of the larvae especially on the appropriate time for the exogenous feeding.

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